FIRST ANNUAL REPORT

OF

DR. F. A. GENTH,

Chemist of the Pennsylvania Board of Agriculture,

TAKEN FROM THE PROCEEDINGS OF THE BOARD.

HARRISBURG:
LANE S. HART, STATE PRINTER.
1878.

tect the acres now cleared off, and valueless for the purposes, until the timber again asserts its supremacy, or we may replant the trees from seedlings in the nursery. We would lay it down as an axiom, (and if we err it is on the safe side,) resulting from data collected by the department, that in *our State* any land not worth more than twenty five dollars per acre, and reasonably accessible, will, if planted with a proper selection of timber, yield a revenue of not less than seven per cent. upon the investment, and in many cases much more. In many cases, as in Union and Cameron counties, large areas when once cleared would, if protected from forest fires, soon replant themselves, and instead of yielding no return would soon become a source of revenue. After a careful examination with the results which have thus far followed attempts to encourage tree planting by State or other bounties, at least so far as eastern States are concerned, we very much doubt the propriety of any such legislation for our State; but that something might be done by protecting our present supply, and affording

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With the Compliments of

Penn'a State Board of Agriculture.

THOS. J. EDGE, Sec'y.

UNIVERSITY OF PENNSYLVANIA,
WEST PHILADELPHIA, *May 16, 1877.*

Secretary Pennsylvania State Board of Agriculture, Harrisburg, Pa.:

DEAR SIR: I beg to submit my report on fertilizers, with especial reference to those used in this Commonwealth.

The time for its preparation was too short to make it complete, but I trust that, incomplete as it is, it contains a good deal of information which may be of value to our farmers.

In compliance with your request, I have added to the analysis of the fertilizers a valuation which shows their comparative merit, although I am not altogether satisfied with the entire correctness of the data upon which this is based; it will give you an approximation at least.

It is a known fact that superphospate of lime, when mixed with a portion of undecomposed bone, phospate of lime or oxides of iron, and alumina, gradually loses its solubility in water, and goes back to an insoluble form. *Such* phosphoric acid is known in commerce as "gone back," "reverted," "reduced or," "precipitated" phosphoric acid

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A very similiar result is obtained when a perfectly soluble supherphosphate of lime is put in the soil. Its phosphoric acid almost immediately becomes insoluble in water, exactly as the reverted phosphoric acid in a fertilizer.

Such precipitated phosphoric acid, however, is not lost to the crops; it is almost as readily assimilated by the plants as the soluble, and for this reason there is hardly any difference in their value.

A far greater difference exists in that of the insoluble phosphoric acid, depending upon the nature of the raw materials which contain it, some being more readily acted upon and the phosphoric acid converted into an available form than others. Phosphoric acid in bones and some varieties of pulverulent guanos, for instance, is certainly worth much more than that of apatite, rock guanoes, and the phosphatic nodules of South Carolina. No distinction between them has been made in the valuation of the fertilizers, as this would not be of much practical value.

I may here remark, that all superphospate manures, in which the value of the insoluble phosphoric acid forms a considerably item, have not been prepared with that care which is necessary to furnish a first-class article.

Very few of the artificial fertilizers contain "actual" ammonia; the nitrogenous matter used, is mostly in the form of dried blood, dried meat, dried fish, &c., &c., and the valuation given is believed to be a fair one.

For the nitrogen in the form of hair, horn, hoof, &c., I have given no valuation, because these substances are so difficult to decompose, that from their nitrogen very little benefit can be derived.

The valuation of the potash in manures is difficult under present circumstances, on account of the great rise in the prices of the purer salts, caused by the war in Europe; in the form of Kainite it still can be obtained at a reasonable figure.

The following are the rates which have been adopted in this report for the valuation of fertilizers:

For soluble and reverted phosphoric acid,	10	cents per pound.
For insoluble phosphoric acid,	4	cents per pound.
For soluble silicic acid (diatoms,)	5	cents per pound.
For potash,	7	cents per pound.
For ammonia,	17½	cents per pound.
For alkaline sulphates,	1	cent per pound.

I believe that they will give a fair representation of the comparative value of our artificial fertilizers.

Yours, very truly,
F. A. GENTH.

The introduction of artificial fertilizers, not many years over a quarter of a century ago, may be considered the beginning of a new era in agriculture.

Their application enabled the farmers, after the exhaustion of their soils by successive abundant crops, and conseqently the removal of vast quantities of plant food, in the form of phosphoric acid and potash, to restore their lands again to fertility, by returning these substances in sufficient amounts to insure full crops.

As it is with every industry, so it was in the manufacture of artificial fertilizers. For the want of experience, many errors were at first committed, and manures were placed on the market which frequently failed to produce the desired result.

This was to a great extent owing to the fact that many fertilizers contained only *one* of the essential constituents, generally only phosphates, and the phosphoric acid* often *not* in a form in which it is readily taken up by the plants, whilst potash and nitrogenous compounds were more or less neglected.

This error was soon discovered, and at present no fertilizer can be considered perfect, unless it contains available phosphoric acid, as well as potash and nitrogen compounds, from which the nitrogen can be readily assimilated by the plants, all in such proportions that, by their application, the two former substances, which have been removed from the soil, are fully restored.

In the following I intended to give the analyses, which I have made of the most important raw materials, at present used in the manufacture of artificial manures, also, analyses of the principal fertilizers, as they are supplied to the farmers of this State.

I. Phosphatic Raw Materials.

1. Bone-ash from Buenos Ayres.

I have made an analysis of a sample from a cargo imported into Baltimore, which I found to contain:

Moisture,	= 1.54
Organic matter,	= 1.26
Carbonic acid,	= 1.13
Sulphuric do.	= 0.28
Phosphoric do.	= 36.48
Lime,	= 45.64
Magnesia,	= 1.15
Sand,	= 9.56
Fluorine, oxide of iron, Chloride of sodium, &c., } not determined,	= 2.96
	100.00

36.48 per cent. of phosphoric acid are equivalent to 79.64 of bone phosphate of lime.

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*As this report is intended principally for the use of farmers, I do not think any one will find fault with me in using the old and familiar chemical nomenclature instead of the more exact modern, as for instance phosphoric acid instead of phosphorus pentoxide or phosphoric anhydride, or potash instead of potassium oxide, &c.

One ton of 2,000 pounds contains 729.6 pounds of phosphoric acid, worth $29 18.

Other samples of "bone-ash" from Buenos Ayres contained:

28.14 per cent. of phosphoric acid, equal to 61.43 per cent. of bone phosphate.
36.20 " " 79.03 " "
38.67 " " 84.42 " "

2. Prairie Bone.

A sample of "fine ground Prairie Bone," obtained in this city, had the following composition:

Moisture, ... =	7.30
Nitrogenous organic matter, ... =	30.27
Bone phosphate of lime, ... =	29.11
Carbonate of lime, ... =	3.71
Ferric oxide, ... =	0.76
Silicic acid, ... =	2.00
Alkaline salts, ... =	26.28
Magnesia, &c., not determined, ... =	0.57
	100.00

The organic matter contained 2.61 nitrogen, equivalent to 3.17 ammonia; the alkaline salts contained 0.36 potash, and the bone phosphate of lime 13.34 phosphoric acid; the value of a ton of this fertilizer would therefore be:

63.4 pounds of ammonia, ...	$11 10
7.2 pounds of potash, ...	50
266.8 pounds of phosphoric acid, ...	10 67
	$22 27

3. Bone-Dust.

I have analyzed several samples of "bone-dust," as it is found in this market, with the following results:

	1.	2.
Phosphoric acid, ... =	15.22	12.60
Equal to bone phosphate of lime, ... =	33.23	27.51
Nitrogen, ... =	2.29	1.89
Equivalent to ammonia, ... =	2.78	2.29

The value of a ton of 2,000 pounds would be:

1. 304.4 pounds of phosphoric acid, ... =	$12 18
55.6 pounds of ammonia, ... =	9 75
	$21 93
2. 252 pounds of phosphoric acid, ... =	$10 08
45.8 pounds of ammonia, ... =	8 02
	$18 10

Bone-dust of Lister Bros., Newark, New Jersey, sold in this city, con- ined:

Moisture, = 10.90
Phosphoric acid, = 10.93
Equivalent to bone phosphate of lime, = 23.86
Nitrogen, = 2.99
Equivalent to ammonia, = 3.63
Sulphate of lime, = 3.38
Sulphate of soda, = 13.75
Sulphate of potash, =Trace.

The value of a ton of 2,000 pounds is:

218.6 pounds of phosphoric acid, = $8 74
72.6 pounds of ammonia, = 12 71
$21 45

4. Bone-Black.

I have analyzed several samples of sugar-house bone-black, and give for mparison the composition of a sample of fine black from a cargo im- rted from England:

Moisture, = 5.22
Sulphuric acid, = 0.10
Sulphur, = 0.11
Phosphoric acid, = 35.40
Carbonic acid, = 2.88
Ferric oxide, = 0.16
Magnesia, = 0.93
Lime, = 43.85
Alkaline salts, = 0.80
Sand, = 0.48
Carbon, = 9.84
Organic matter, = 0.23
100.00

)ther samples contained: 37.87, 35.24, 34.92, 33.90, 32.73, 35.79, and 3 44 per cent. of phosphoric acid, giving an average of 35.25 per cent; or, 7 pounds per ton, in value equal to $28.20.

'or comparison, I give the results of analyses, which I have made, of "ure ground steamed bones," and "ground roasted bones," manufactured b the Bradley Fertilizer Company, of Boston, Massachusetts.

5. Pure Ground Steamed Bones.

Phosphoric acid, = 22.82
Equivalent to bone phosphate of lime, = 49.82
Nitrogen, = 3.43
Equivalent to ammonia, = 4.16

Their value per ton is:

456.4 pounds of phosphoric acid, ...	=$18 26
83.2 pounds of ammonia, ...	= 14 56
	$32 82

6. Ground Roasted Bones.

Phosphoric acid, ...	= 24.87
Equivalent to bone ph. of lime, ...	= 54.29
Nitrogen, ...	= 3.41
Equivalent to ammonia, ...	= 4.14

A ton contains, therefore:

497.4 pounds of phosphoric acid, worth, ...	$19 90
82.8 pounds of ammonia, worth, ...	14 49
	$34 39

Bones, in their various forms, are, undoubtedly, the best material for th manufacture of artificial manures, but, unfortunately, the supply is to limited for the enormous production of the latter; therefore, immediatel after the so-called superphosphate of lime-fertilizers were introduced, th whole world was searched over, and many localities were discovered, fron which an abundant supply of phosphates could be obtained.

One of the richest is the natural phosphate of lime.

7. Apatite.

It is a combination of fluoride, or chloride of calcium, with phosphat of lime, containing, in its pure state, about forty-two per-cent. of phosphoric acid.

Small quantities of apatite have been observed in the gneissic rocks an some of the limestone beds of Chester, Delaware, and Philadelphia counties; large beds of it have been discovered in similar rocks in Canada, on of fifteen feet in thickness, containing, on an average, about eighty-five pe cent. of bone phosphate of lime.

It is to be hoped that when the geological survey of the south-easter counties of Pennsylvania is undertaken, similar deposits may be found.

Large bodies of a fibrous variety of apatite, so-called “phosphorite, yielding from fifty to eighty-five per cent. of bone phosphate of lime occu in Spain. They might be brought to this country as ballast, for a pric which would enable manufacturers to make use of this important ra material for the manufacture of superphosphates.

Many islands in the Pacific and Atlantic oceans, which are inhabited b innumerable sea birds, which there live, and die, and decay, together wit the food on which they lived, furnish very valuable manures, some read for immediate application, others which serve as a raw material for artif cial fertilizers.

It is evident that at localities where the decomposition of this larg quanity of animal matter is going on, without interruption, in a rainles country and under a hot sun, the quality of the guano thus formed must be of an entirely different character from that which is produced, where frequent rains, or the sea water, have washed out everything that was soluble.

In the first mentioned places guanoes, rich in nitrogenous compounds, ammoniacal and potash salts are formed. To this class belong, above all others, the "Peruvian guanoes," of which I shall speak further on. The guanoes, which have been deprived of their soluble constituents by rain or sea water, are frequently rich in phosphoric acid, containing mostly phosphates of lime and magnesia, sometimes contaminated with phosphates of iron and alumina, all more or less mixed with carbonate of lime, sulphate of iron, &c., &c.

It would be tedious to enumerate the many localities, and to give the nalyses of such phosphatic guanoes. I will mention only Jarvis and Baker's Island, in the Pacific, where rich phosphates of lime occur, mixed with gypsum or hydrous sulphate of lime; and the islands in the Carribean ea, near the coast of Venezuela, which furnishes the so-called "Columbian guano," amongst them prominently Bird's Island, Orchilla, and Monk's sland; then the Swan Islands, near the coast of Honduras; Sombrero nd Navassa.

At present none of these islands furnish phosphates for the market, with he exception of the two latter, Sombrero and Navassa, from which still mall quanities of rock guano are imported, which are employed in the anufacture of fertilizers, used in the Commonwealth.

All the others have been driven from the market since the development f the beds of phosphatic nodules in South Carolina, which were discoved in August, 1867, and from which phosphates can be furnished for less an the freight from the other sources would amount to. Should the deosits in the neighborhood of Charleston, S. C., ever be exhausted, the hosphates from the numerous other localities would again find a ready arket.

8 and 9. Sombrero and Navassa.

As the phosphatic guanoes of Sombrero and Navassa are still used in e maufacture of fertilizers, I will give the analyses of average samples om cargoes, imported into this city and Baltimore, for comparison with e phosphatic nodules of South Carolina:

	Sombrero.		Navassa.	
	1	2.	1.	2.
Moisture,	= 3.07	2.84	7.90	10.70
Organic matter,	= 2.40	2.50	21.30	20.77
Ferric oxide and alumina,	= 3.03	2.19		
Magnesia,	= 0.60	0.62	0.29	0.37
Lime,	=46.43	46.48	36.68	35.99
Phosphoric acid,	=32.89	31.92	31.93	30.57
Carbonic acid,	= 8.73	10.47	1.90	1.60
Sand,	= 2.45	1.05	.	
Undertermined,	= 0.40	1.93	. .	. .

From numerous analyses, I find the average yield of Sombrero and Navassa guano about 30.5 per cent. of phosphoric acid, equal to 66.58 per cent. of bone phosphate of lime.

10. South Carolina Nodules.

The average yield of the last twenty-five analyses of "South Carolina phosphatic nodules," which I have made, gave me 23.7 per cent. of phosphoric acid, equivalent to 51.74 per cent. of bone phosphate of lime.

II. Potassic Raw Materials.

Since the discovery of the inexhaustible potash beds in the rock salt mines of Stassfurt, Leopoldshall, &c., in Prussia, the use of salts of potash has rapidly increased in the manufacture of artificial fertilizers.

They are principally three salts, which are employed for this purpose, the sylvite, or muriate of potash, the sulphate of potash, which is usually made from the muriate, and kainite, a mixture of sulphates of potash, soda, and magnesia, in variable proportions.

As I have made no complete analysis of either of these salts, I insert the analyses of Professor C. A. Goessmann, from his fourth annual report to the Massachusetts Board of Agriculture:

1. Muriate of Potash.

The samples were obtained from dealers in Massachusetts.

	1.	*2.*	*3.*	*4.*
Potassium oxide, ... =	50.70	52.89	50.42	52.40
Sodium oxide, ... =	7.84	7.20	8.73	8.89
Chlorine, ... =	49.33	. .	47.94	. .
Moisture, ... =	2.60	2.50	3.67	. .
Insoluble matter, (in water,) =	0.80	. .	. .	0.44

They contain from eighty to eighty-four per cent. of muriate of potash, (chloride of potassium,) and were sold at retail from fifty-five to sixty dollars per ton of two thousand pounds, or from five and a half to six cents per pound of potash, making the muriate of potash one of the cheapest sources of potash for agricultural purposes.

I do not know their present price, but as it is also the best source fo the manufacture of saltpeter for gunpowder, the present war between Russia and Turkey must have advanced the price to a considerable extent.

2. Sulphate of Potash.

As there is a better demand for sulphate of potash than for the muriate on account of the superior fertilizing properties of the former, a large portion of the muriate imported from Germany is, in Boston and New York converted into sulphate of potash by means of sulphuric acid. The produc consists chiefly of sulphates of potash and soda, with more or less fre sulphuric acid, or rather with an admixture of acid sulphates of potash an soda.

Professor Goessmann gives the following analyses:

	1.	2.	3.
Potassium oxide, ... =	35.44	33.40	30.82
Sodium oxide, ... =	5.50	4.50	8.59
Calcium oxide, ... =	Trace.	Trace.	Trace.
Magnesium oxide, ... =	Trace.	Trace.	Trace.
Sulphuric acid, ... =	52.10	59.30	42.34
Insoluble matter, (in water,) . . =	0.44	0.88	0.60
Moisture, ... =	0.20	0.19	. .

These sulphates were sold at from sixty to sixty-five dollars per ton, or from eight and one half to nine and one half cents per pound of potash.

3. Kainite.

A large quanity of sulphate of potash in artificial fertilizers is obtained from the so-called "Kainite" and "Stassfurt Dungsalt." These are mixtures, in variable proportions, of the minerals: Picromerite, a hydrous double salt of sulphates of potash and magnesia, sylvite (chloride of potassium,) and rock salt (chloride of sodium.) Those richer in potash are usually sold under the name Kainite, (1 and 2,) the poorer as "Stassfurt Dungsalt," (3.)

Professor Goessmann's analyses were made of samples obtained from dealers in Massachusetts.

	1.	2.	3.
Potassium oxide, ... =	25.02	24.82	9.69
Sodium oxide, ... =	Not detd.	7.17	16.36
Magnesium oxide, ... =	8.40	11.97	4.54
Calcium oxide, ... =	2.92	Not detd.	1.61
Sulphuric acid, ... =	17.62	17.20	9.86
Chlorine, ... =		Not detd.	
Insoluble matter, (in water,)=	2.90	. .	5.17
Moisture, ... =	5.50	5.40	10.00

III. Nitrogenous Raw Materials.

1. Sulphate of Ammonia.

This salt is imported from Europe in large qnanities, but also manufacured in this city and elsewhere, from the ammoniacal liquors, &c., produced at gas-works. It is the most valuable of all the nitrogenous raw materials which, in a pure state, contains 25.75 per cent. of ammonia. Some of the manufacturers of artificial fertilizers in this city use it for their ammoniated superphosphates.

As I made no analyses of any, I give those of Professor Goessmann, of three samples obtained from dealers in Massachusetts:

	1.	2.	3.
Nitrogen,	=20.57	20.60	21.00
Ammonia,	=25.00	25.18	25.50
Sulphuric acid,	=59.30	. .	60.00
Moisture,	= 2.70	. .	2.00

2. Nitrate of Soda, (Chili Saltpeter.)

This is another very important source of nitrogen for artificial fertilizers, which is sometimes used by manufacturers in this city.

The standard strength prescribed by the Peruvian Government is ninety-five per cent. A sample obtained from a dealer in Boston gave Professor Goessmann:

Nitric acid,	=60.82
Sodium oxide,	=35.68
Calcium oxide,	= 0.13
Magnesium oxide,	= 0.04
Chlorine,	= 0.46
Sulphuric acid,	= 0.08
Insoluble matter, (in water,)	= 0.24
Moisture,	= 2.00

It contained 95.7 per cent. of nitrate of soda; the amount of nitrogen in this quanity is equivalent to 19.14 ammonia.

It has been sold last year for about four cents per pound; the price has since considerably risen on account of the war in Europe.

3. Slaughter-House Offal.

Much attention has been given in late years to the highly nitrogenous refuse articles of slaughter-houses, fat rendering establishments, &c.; and in this manner large quantities of very valuable materials have been saved for the production of aritficial fertilizers. These substances are usually sold under the names: Dried blood, dried meat, nitrogenous matter, animal matter, ammoniacal matter, azotine, cracklings, bone and meat, tanking, &c.

As will be seen from the analyses given below, that their value as fertilizers is even more variable than their names.

The great advantage which all these substances have over others, equally rich in nitrogen, is owing to the fact that their nitrogen is readily converted into ammonia and in this form easily assimilated by the plants.

The following analyses will give an idea of their comparative value:

a. Dried Blood.

Sample 1 is from a dealer in Baltimore, 2, 3, 4, and 5, are from dealers in this city, 6 from the N. W. Fertilizing Company of Chicago.

	1.	2.	3.	4.	5.	6.
Moisture, ... =	not detd.	49.23	13.14	not detd.	10.69	not detd.
Nitrogen, ... =	12.16	7.21	8.58	13.56	11.86	13.96
Equiv. to Ammonia, =	14.77	8.75	10.42	16.46	14.40	16.95

All the samples contained a small quanity of phosphoric acid, which was not determined.

Their value per ton varies from $30 63 to $59 33, chiefly owing to their state of dryness.

b. Azotine, Azote-Guano—Dried Meat—Animal Matter, Nitrogenous Matter, Crackling, &c.

Mostly obtained from flesh, which is worthless as food, after the extraction of the fat.

Samples 1, 2, and 3 were obtained from dealers in Baltimore, 4 is Amor, Smith & Son's Azotine, 5 Dey's Azotine, 6 and 7 are from dealers in this city.

	1.	2.	3.	4.	5.	6.	7.
Moisture, ... =	. .	. .	. .	8.54	. .	. .	13.19
Nitrogen, ... =	9.56	7.61	13.68	11.39	10.78	10.65	8.37
Equiv. to Ammonia, . =	11.61	9.27	16.61	13.83	13.09	12.94	10.16

They all contained an undetermined amount of phosphoric acid.

Their value varies from $32 45 to $58 14 per ton of 2,000 pounds.

c. Meat and Bone. Tanking.

Those varieties, which contain considerable quanities of bones, are sold nder the names Tanking, or "Meat and Bone."

Samples 1, 2, and 3 are from this market, 4 is from Baltimore, and 5 rom Texas.

	1.	2.	3.	4.	5.
oisture, ... =	. .	11.84	8.31	22.30	9.50
itrogen, ... =	4.28	4.13	6.12	3.22	3.71
quiv. to Ammonia, ... =	5.20	5.02	7.43	3.91	4.50
hosphoric acid, ... =	7.27	18.58	5.70	6.15	17.03
quiv. to bone ph. of lime, ... =	15.87	40.55	12.44	13.43	37.18
and, ... =	. .	. .	. .	. .	14.15

The great difference in the composition of all these refuse articles shows he great necessity of a careful chemical investigation, in order to establish heir commercial value.

4. Fish Guano.

Under this name, fertilizers of variable value are sold in this market. I ive partial analyses of two, (1 and 2,) which I have made, and, for comarison, the analysis of "marine guano," of J. J. Allen's Sons, of this city, 3,) which is published in the fourth annual report of the New Jersey tate Board of Agriculture:

	1.	2.	Marine Guano, J. J. Allen's Sons 3.
Moisture, ... =	. .	42.50	. .
Nitrogen, ... =	8.33	4.12	. .
Equivalent to ammonia, ... =	10.11	5.00	3.58
Phosphoric acid, soluble, ... =	Not determined.		2.66
Phosphoric acid, soluble citr. ammonia, =			3.69
Phosphoric acid, insoluble, ... =			1.62
Potash, ... =			1.61

5. Horn, Hoof, Leather, Hair, Woolen Rags, &c.

There are several other animal refuse matter which contains a large percentage of nitrogen, and which would be of great value in fertilizers, i they were more readily decomposed; this, however, is unfortunately no the case, and their value as nitrogeneous fertilizers is comparatively small. These substances are horn, hoof, leather, hair, woolen rags, &c., and wherever they are found as essential constituents of manures, the latte should be looked upon with suspicion.

I have analyzed several samples, found in this market, with the following results:

	Ground horn. 1.	Ground hoof. 2.	 3.	Horn and hoof 4.
Nitrogen, ... =	13.18	12.57	13.07	13.14
Equivalent to ammonia, ... =	16.00	15.27	15.86	15.96
Phosphoric acid, ... =	2.37	Not determined.		
Sulphuric acid, ... =	0.57	"	"	
Lime, ... =	3.02	"	"	
Magnesia, carbonic acid, &c., . . =	0.86	"	"	

	Leather refuse. 5.	Hair refuse 6.
Nitrogen, ... =	4.65	6.57
Equivalent to ammonia, ... =	5.65	7.98

6. Castor Bean Pomace,

I will here mention another valuable source of nitrogen, which lately has been used advantageously in the manufacture of artificial fertilizers it is the castor bean pomace. Its constitution is readily destroyed, and its nitrogen easily assimilated by plants.

The analyses which I have made gave the following results:

	1.	2.	3.	4.	5.
Moisture, ... =	8.94	6.85	7.98	6.34	9.3
Nitrogen, ... =	5.71	6.97	7.33	7.28	6.8
Equivalent to ammonia, ... =	6.94	8.46	8.90	8.84	8.2

This gives, on an average, 8.28 per cent. of ammonia, or 165.6 pounds per ton of 2,000 pounds, equal to $28.98.

IV. Natural Fertilizers.

Several guanoes, containing a portion of their phosphoric acid in an assimilable form, and, besides, nitrogenous componds and salts of ammonia and potash, are used as fertilizers, without previous manipulation.

1. Moro Phillips' Serreno Guano.

The analysis of this guano has been made by Doctor T. R. Wolf, State Chemist of Delaware, and has been kindly communicated by him. He found:

Soluble and precipitated phosphoric acid,	= None.
Insoluble,	= 15.96
Ammonia,	= 0.75
Potash,	= 0.69

A ton of 2,000 pounds contains:

319.2 pounds of phosphoric acid, worth,	$12 77
15 pounds of ammonia, worth,	2 63
13.8 pounds of potash, worth,	97
	$16 37

2. Guanahani Guano.

This seems to be a "bat" guano. It is imported from the island Guanahani, or San Salvador, in the Bahamas, by the Guanahani Guano Company, and is sold by its general agent, Mr. W. R. Griffith, of Baltimore, from whom the sample for analysis was received. It contains:

Phosphoric acid,	=12.19
Equivalent to bone phosphate of lime,	=26.61
Nitric acid,	= 3.01
Equivalent to ammonia,	= 0.94
Sulphuric acid,	= 0.81
Potash,	= 0.20
Soda,	= 0.63
Lime,	=18.16
Magnesia,	= 0.52
Nitrogen, (additional,)	= 2.03
Equivalent to ammonia,	= 2.47

A portion of the phosphoric acid is soluble in citrate of ammonia, but he amount has not been determined.

The value of a ton of this guano would be:

243.8 pounds of phosphoric acid, worth,	$9 75
68.2 pounds of ammonia, worth,	11 94
4 pounds of potash, worth,	28
	$21 97

3. Peruvian Guano.

From a pamphlet, issued January, 1877, by Messrs. Hobson, Hurtado & o., of New York, the agents of the Peruvian Government, we learn that the sale of this very important fertilizer is now regulated in the following manner:

The agents guarantee the guano to be pure, genuine Peruvian, which has not been damaged by sea water. It is offered for sale in the following brands, viz:

No. 1. Peruvian guano.
No. 1. Peruvian guano—Lobos.
No. 1. Peruvian guano—guaranteed.
No. 2. Peruvian guano.

No. 1. Peruvian Guano,

Is the crude article, as brought from Peru; it is guaranteed to average ten per cent. of ammonia. The mechanical condition of this brand is *not* guaranteed, and it often contains lumps, which require crushing before using.

The price is sixty dollars per ton of two thousand two hundred and forty pounds, in lots of ten tons.

Amongst dealers, this brand is know as "Standard Guano;" all others above ten per cent. are called above standard, whilst those containing less than ten per cent. are below standard.

No. 1. Peruvian Guano—Lobos,

Is the guano from Lobos Island, or Lobos Point, in Peru. It is sold under the same guarantee as No. 1 Peruvian Guano, as to its genuineness, absence of sea-water damage, and mechanical condition, and is warranted to analyze by the cargo, at the time of arrival, six per cent. of ammonia. It often contains seven per cent., and is rich in phosphoric acid and potash. The price of this brand in parcels of ten tons, is fifty one dollars per ton of two thousand two hundred and forty pounds.

No. 1. Peruvian Guano—guaranteed.

This is a genuine Peruvian Guano, which after discharge from the vessel, has been overhauled, the lumps have been crushed, and the stones and other impurities have been removed by screening. The guano is therefore in a purer condition than when imported. Every condition that could interest the farmer is guaranteed. It is warranted to be genuine, free from sea-water damage, and in a dry powdery condition, fit for immediate use in the drill. It is sold by actual analysis, which is printed on every bag.

The retail price per ton of two thousand pounds is the sum of its valuable constituents, charged at the following rates:

For ammonia, ...	17¼	cents	per pound.
For soluble phosphoric acid, ...	10	do.	do.
For reverted phosphoric acid, ...	8	do.	do.
For insoluble phosphoric acid, ...	2	do.	do.
For potash, ...	7½	do.	do

No. 2. Peruvian Guano.

This is mostly consumed in Peru, and only a few small cargoes have been sent to New York as an experiment.

It comes from the lower beds of the guano deposits, and consequently contains much more sand than is ever found in No. 1 Peruvian Guano.

It is sold by analysis; the retail price per ton of two thousand pounds is fixed at the following rates, for the fertilizing ingredients:

For ammonia,	17½	cents per pound.
For phosphoric acid,	8	do. do.
For potash,	7½	do. do.

I have made the following analyses of Peruvian Guanoes:

"Standard X per cent. Guano"—cargo "Andrew Johnson."

Soluble phosphoric acid,	= 3.19	per cent.
Precipitated phosphoric acid,	= 8.54	do.
Insoluble phosphoric acid,	= 0.24	do.
Ammonia,	=10.39	do.
Potash,	= 2.90	do.

Value:	234.6	pounds sol. and prec. phosphoric acid, @ 10 cents,	=$23 46
	4.8	pounds insoluble phosphoric acid, @ 4 cents,	= 19
	207.8	pounds ammonia, @ 17½ cents,	= 36 37
	58	pounds potash, @ 7 cents,	= 4 06
			$64 08

"Lobos Guano"—cargo "Norseman."

Soluble phosphoric acid,	= 2.51	per cent.
Precipitated phosphoric acid,	=16.50	do.
Insoluble phosphoric acid,	= 2.35	do.
Ammonia,	= 5.77	do.
Potash,	= 2.35	do.

alue:	380.2	pounds sol. and prec. phosphoric acid, @ 10 cents,	=$38 02
	47	pounds insoluble phosphoric acid, @ 4 cents,	= 1 88
	115.4	pounds ammonia, @ 17½ cents,	= 20 20
	47	pounds potash, @ 7 cents,	= 3 29
			$63 39

V. Artificial Fertilizers.

1. No. 1 Peruvian Guano—Rectified.

The agents for the Peruvian Government offer for sale, under this name, pure Peruvian guano, mixed with sulphuric acid. By this means the mmonia, which otherwise would partly volatilize and be lost, is fixed, and also much less liable to injure the plants.

By the addition of sulphuric acid, the phosphoric acid is also rendered luble, and is, therefore, more easily assimilated.

All conditions of interest to the farmer are warranted. It is dry, pow-ery, and the analysis is printed on each bag.

The rectified guano does not represent any particular grade; it may contain four per cent. of ammonia, and may contain ten per cent. and more.

The retail price is regulated at the following rates:

For ammonia,	20	cents per pound.
For soluble phosphoric acid,	10	do. do.
For reverted do.	8	do. do.
For insoluble do.	Nil.	
For potash,	7½	do. do.

2. Dissolved Mejilones Guano.

The Mejilones Island lies on the coast of Peru, and the phosphatic guano found there is the raw material for a rich superphosphate of lime, manufactured by Messrs. P. S. Chappell & Son, of Baltimore, who have furnished the sample for analysis. It contains:

Moisture,	=19.56	per cent.
Soluble phosphoric acid,	=17.71	"
Reverted,	= 2.08	"
Insoluble,	= 0.48	"
Ammonia,	= 0.62	"

The value of this fertilizer of one ton of two thousand pounds is:

354.2	pounds of soluble phosphoric acid,	$35 42
41.6	do. reverted do.	4 16
9.6	do. insoluble do.	0 38
12.4	do. ammonia do.	2 17
		$42 13

3. Baugh's Challenge Superphosphate.

This is an English fertilizer, and is imported by Messrs. Baugh & Sons, of this city.

The sample for analysis was obtained through the secretary of the Pennsylvania State Board of Agriculture from Mr. John I. Carter, superintendent of State Experimental Farm. It contained:

Moisture,	= 7.87	per cent.
Soluble and reverted phosphoric acid,	=30.10	do.
Equivalent to bone phosphate of lime,	=65.71	do.
Insoluble phosphoric acid,	= 0.22	do.
Equivalent to bone phosphate of lime,	= 0.56	do.
Potash,	= 0.05	do.
Ammonia,	= 0.085	do.

The value of this fertilizer per ton of two thousand pounds is:

602	pounds available phosphoric acid	$60 20
4.4	do. insoluble do.	0 18
		$60 38

4. "Baugh's Dissolved South Carolina Rock."

Manufactured by Messrs. Baugh & Sons, of this city.

The sample for analysis was sent by the secretary of the Board of Agriculture.

It contained:

Moisture,	=	4.00	per cent.
Soluble and reverted phosphoric acid,	=	13.62	do.
Equivalent to bone phosphate of lime,	=	29.73	do.
Insoluble phosphoric acid,	=	5.14	do.
Equivalent to bone phosphate of lime,	=	11.22	do.
Potash,	=	0.11	do.
Ammonia,	=	0.23	do.

The value of one ton of two thousand pounds is:

272.4	pounds soluble and reverted phosphoric acid,	=	$27	24
102.8	do. insoluble, do.	=	4	11
2.2	do. potash,	=	0	15
4.6	do. ammonia,	=	0	80
			$32	30

5. "Ammoniated Dissolved Bone."

Manufactured by Messrs. Baugh & Sons, of this city.

Sample for analysis received from the secretary of the Pennsylvania Board of Agriculture.

It contained:

Moisture,	=	3.58	per cent.
Soluble and reverted phosphoric acid,	=	10.15	do.
Equivalent to bone phosphate of lime,	=	22.16	do.
Insoluble phosphoric acid,	=	0.47	do.
Equivalent to bone phosphate of lime,	=	1.03	do.
Nitrogen,	=	3.13	do.
Equivalent to ammonia,	=	3.80	do.

Value per ton of two thousand pounds:

203	pounds soluble and reverted phosphoric acid,	=	$20	30
9.4	do. insoluble do.	=	0	38
76	do. ammonia,	=	13	30
			$33	98

6. "Whann's Acid Phosphate."

Manufactured by Messrs. Walton, Whann & Co., of Philadelphia, and Wilmington, Delaware.

The sample for analysis received from the secretary of the Pennsylvania tate Board of Agriculture.

It contains:

Moisture, = 4.98 per cent.
Soluble and reverted phosphoric acid, =13.48 do.
Equivalent to bone phosphate of lime, =29.43 do.
Insoluble phosphoric acid, = 2.36 do.
Equivalent to bone phosphate of lime, = 5.15 do.

The value of one ton of two thousand pounds would be:

269.6 pounds soluble and reverted phosphoric acid, =$26 96
47.2 do. insoluble, do. = 1 89

$28 85

7. "Whann's Phosphate,"

Manufactured by Messrs. Walton, Whann & Co., of Philadelphia, and Wilmington, Delaware. The sample for analysis was sent by the secretary of the Pennsylvania State Board of Agriculture.

It contained:

Moisture, = 5.85 per cent.
Soluble and reverted phosphoric acid, = 9.70 do.
Equivalent to bone phosphate of lime, =21.18 do.
Insoluble phosphoric acid, = 3.86 do.
Equivalent to bone phosphate of lime, = 8.43 do.
Potash, = 2.27 do.
Nitrogen, = 2.24 do.
Equivalent to ammonia, = 2.72 do.

One ton of two thousand pounds contains:

194	pounds soluble and reverted phosphoric acid, worth,	$19 40
77.2	pounds insoluble phosphoric acid, worth,	3 09
45.4	pounds potash, worth,	3 18
54.4	pounds ammonia, worth,	9 42
		$35 19

8. "Sun Guano,

Manufactured by Messrs Walton, Whann & Co., of Philadelphia, and Wilmington, Delaware.

The sample for analysis was furnished by the secretary of the Pennsylvania State Board of Agriculture.

The analysis gave:

Moisture, = 1.50 per cent.
Soluble and reverted phosphoric acid, = 5.32 do.
Equivalent to bone phosphate of lime, =11.61 do.
Insoluble phosphoric acid, = 3.07 do.
Equivalent to bone phosphate of lime, = 6.70 do.
Potash, = .18 do.
Nitrogen, = 1.67 do.
Equivalent to ammonia, = 2.03 do.

The value of one ton of this fertilizer is as follows:

166.4 pounds sol. and reverted phosphoric acid,	=$10 64
61.4 pounds insoluble phosphoric acid,	= 2 46
3.6 pounds potash,	= 25
40.6 pounds ammonia,	= 7 11
	$20 46

9. "Lennig's Dissolved South Carolina Rock,

Manufactured by Mr. Charles Lennig, of Philadelphia. The sample for nalysis was sent by the secretary of the Pennsylvania State Board of Agriculture.

It contained:

Moisture,	= 1.98	per cent.
Soluble and reverted phosphoric acid	= 9.66	do.
Equivalent to bone phosphate of lime,	=21.09	do.
Insoluble phosphoric acid,	= 6.76	do.
Equivalant to bone phosphate of lime,	=14.76	do.

The value of one ton of this fertilizer is:

193.2 pounds of sol. and reverted phosphoric acid,	=$19 32
135.2 pounds of insoluble phosphoric acid,	= 5 41
	$24 73

10. "Moro Phillips' Phosphate,"

anufactured by Mr. Moro Phillips, Philadelphia.

The sample for analysis was received from the secretary of the State oard of Agriculture, and contained:

Moisture,	= 4.23	per cent.
Soluble and reverted phosphoric acid,	= 8.94	do.
Equivalent to bone phosphate of lime,	=19.52	do.
Insoluble phosphoric acid,	= 5.85	do.
Equivalent to bone phosphate of lime,	=12.77	do.
Potash,	= 1.82	do.
Nitrogen,	= 1.75	do.
Equivalent to ammonia,	= 2.13	do.

One ton of 2,000 pounds contains:

178.8 pounds soluble and reverted phosphoric acid,	=$17 88
117 pounds insoluble phosphoric acid,	= 4 68
36.4 pounds potash,	= 2 55
42.6 pounds ammonia,	= 7 46
	$32 57

11. "Phuine,"

anufactured by Mr. Moro Phillips, of Philadelphia.

The sample for analysis was received from the secretary of the State Board of Agriculture, and contained:

Moisture, ... = 4.95 per cent.
Soluble and reverted phosphoric acid, . . =10.03 do.
Equivalent to bone phosphate of lime, . . =21.91 do.
Insoluble phosphoric acid, ... = 4.89 do.
Equivalent to bone phosphate of lime . . =10.68 do.
Potash, ... = 0.24 do.
Nitrogen, ... = 2.55 do.
Equivalent to ammonia, ... = 3.10 do.

The value of one ton of 2,000 pounds, is as follows:

200.6 pounds soluble and reverted phosphoric acid, =$20 06
97.8 pounds insoluble phosphoric acid, ... = 3 91
4.8 pounds potash, ... = 34
62 pounds ammonia, ... = 10 85

$35 16

12. "Genuine Phosphate,"

Manufactured by Mr. W. H. Jones, of Philadelphia, and sent for examination by the secretary of the Pennsylvania State Board of Agriculture. It contains:

Moisture, ... = 4.35 per cent.
Soluble and reverted phosphoric acid, . . =12.68 do.
Equivalent to bone phosphate of lime, . . =27.68 do.
Insoluble phosphoric acid, ... = 3.36 do.
Equivalent to bone phosphate of lime, . . = 7.33 do.
Potash, ... = 0.09 do.
Nitrogen, ... = 1.20 do.
Equivalent to ammonia, ... = 1.53 do.

The valuation of one ton of 2,000 pounds, gives as follows:

253.6 pounds soluble and reverted phosph. acid, . =$25 36
67.2 pounds insoluble phosph. acid, ... = 2 69
1.8 potash, ... = 13
30.6 pounds ammonia, ... = 5 36

$33 54

13. "National Soluble Bone,"

Manufactured by the "United States Fertilizing and Chemical Company," of Philadelphia, who furnished the sample for analyis. It contains:

Moisture, ... = 8.20 per cent.
Soluble phosphoric acid, ... =11.08 do.
Equivalent to bone phosphate of lime. . . =24.19 do.
Reverted phosphoric acid, ... = 3.54 do.
Equivalent to bone phosphate of lime, . . = 7.71 do.
Insoluble phosphoric acid, ... = 0.37 do.
Equivalent to bone phosphate of lime, . . = 0.81 do.

The value of a ton of 2,000 pounds, is as follows:

292.4 pounds soluble and reverted phosphoric acid is worth, . . .	$29 24
7.4 pounds insoluble phosphoric acid is worth, ...	30
	$29 54

14. "Acidulated Phosphate,"

Manufactured by the New Jersey Chemical Company, of Philadelphia.

The analysis has been made and kindly been communicated by Doctor T. R. Wolf, State Chemist of Delaware. It contains:

Soluble and reverted phosphoric acid, . . =16.63 per cent.
Equivalent to bone phosphate of lime, . . =36.60 do.
Insoluble phosphoric acid, ... = 1.21 do.
Equivalent to bone phosphate of lime, . . = 2.64 do.

The value of one ton of 2,000 pounds, is as follows:

332.6 pounds available phosphoric acid, ... =	$33 26
24.2 pounds insoluble phosphoric acid, ... =	97
	$34 23

15. "Ammoniated Superphosphate of Lime,"

anufactured by the New Jersey Chemical Company, of Philadelphia, ho communicated the sample for analysis. It contains:

Soluble phosphoric acid, ... = 7.48 per cent.
Equivalent to bone phosphate of lime, . . =16.33 do.
Reverted phosphoric acid, ... = 5.63 do.
Equivalent to bone phosphate of lime, . . =12.29 do.
Insoluble phosporic acid, ... = 1.46 do.
Equivalent to bone phosphate of lime, . . = 3.19 do.
Nitrogen, ... = 1.29 do.
Equivalent to ammonia, ... = 1.57 do.

The value per ton is:

262.2 pounds soluble and reverted phosphoric acid, =	$26 22
29.2 pounds insoluble phosphoric acid, ... =	1 17
31.4 pounds ammonia, ... =	5 50
	$32 89

16. "Acidulated South Carolina Phosphate."

This manure is sold by Messrs. Sharpless & Carpenter, of Philadelphia. he analysis has been made by Doctor T. R. Wolf, the State Chemist of elaware, who favored me with his results, as follows:

Soluble phosphoric acid, ... =12.96 per cent.
Equivalent to bone phosphate of lime, . =28.29 do.
Reverted phosphoric acid, ... = 3.58 do.
Equivalent to bone phosphate of lime, . . = 7.81 do.
Insoluble phosphoric acid, ... = 1.26 do.
Equivalent to bone phosphate of lime, . . = 2.75 do.

This represents the following value per ton of 2,000 pounds:

330.8 pounds soluble and reverted phosphoric acid,	=$33 08
25.2 pounds insoluble phosphoric acid, ...	= 1 01
	$34 09

17. "Pelican Guano."

This sample for analysis was procured by the secretary of the Pennsylvania State Board of Agriculture, from Messrs. J. J. Allen's Sons, of Philadelphia, and contained as follows:

Moisture, ...	= 4.85	per cent.
Soluble and reverted phosphoric acid, . .	=14.84	do.
Equivalent to bone phosphate of lime, . .	=32.40	do.
Insoluble phosphoric acid, ...	= 3.81	do.
Equivalent to bone phosphate of lime, . .	= 8.32	do.
Potash, ...	= 1.40	do.
Nitrogen, ...	= 1.16	do.
Equivalent to ammonia, ...	= 1.39	do.

The value of this fertilizer is as follows:

296.8 pounds soluble and reverted phosphoric acid,	=$29 68
76.2 pounds insoluble phosphoric acid, ...	= 3 05
28 pounds potash, ...	= 1 96
27.8 pounds ammonia, ...	= 4 87
	$39 56

18. "High Grade Phosphate,"

Manufactured by the Farmers' Bone and Fertilizing Company, of Philadelphia. The sample for analysis was received from the secretary of the Pennsylvania State Board of Agriculture. It contains:

Moisture, ...	= 6.65	per cent.
Soluble and reverted phosphoric acid, . .	= 7.53	do.
Equivalent to bone phosphate of lime, . .	=16.44	do.
Insoluble phosphoric acid, ...	= 5.26	do.
Equivalent to bone phosphate of lime, . .	=11.48	do.
Potash, ...	= 0.50	do.
Nitrogen, ...	= 1.67	do.
Equivalent to ammonia, ...	= 2.03	do.

The value of one ton of this fertilizer is as follows:

150.6 pounds soluble and reverted phosphoric acid,	=$15 06
105.2 pounds insoluble phosphoric acid, ...	= 4 21
10 pounds of potash, ...	= 70
40.6 pounds of ammonia, ...	= 7 11
	$27 08

19. "High Grade Nitro-phosphate."

This is also manufactured by the Farmers' Bone and Fertilizing Company, of Philadelphia, and the sample for analysis was sent by the secretary of the Pennsylvania State Board of Agriculture. It contains:

Moisture,	= 8 43	per cent.
Soluble and reverted phosphoric acid,	= 8.05	do.
Equivalent to bone phosphate of lime,	=17.57	do.
Insoluble phosphoric acid,	= 4.56	do.
Equivalent to bone phosphate of lime,	= 9.95	do.
Potash,	= 2.00	do.
Nitrogen,	= 1.70	do.
Equivalent to ammonia,	= 2.06	do.

This composition represents the following value per ton:

61	pounds of soluble and reverted phosphoric acid,	=$16 10
91.2	pounds of insoluble phosphoric acid,	= 3 65
40	pounds of potash,	= 2 80
41.2	pounds of ammonia,	= 7 21
		$29 76

20. "Improved Acid Phosphate."

This, also, is manufactured by the Farmers' Bone and Fertilizing Comany, of Philadelphia. A sample, furnished by the secretary of the Pennylvania State Board of Agriculture, contains:

Moisture,	= 3.52	per cent.
Soluble and reverted phosphoric acid,	= 9.49	do.
Equivalent to bone phosphate of lime,	=20.72	do.
Insoluble phosphoric acid,	= 8.14	do.
Equivalent to bone phosphate of lime,	=17.76	do.
Nitrogen,	= 0.45	do.
Equivalent to ammonia,	= 0.54	do.

One ton of this fertilizer is worth as follows:

189.8 pounds soluble and reverted phosphoric acid,	=$18 98
162.8 pounds insoluble phosphoric acid,	= 6 51
10.8 pounds ammonia,	= 1 89
	$27 38

21. "Tree, Vine, and Plant Fertilizer,"

anufactured by the Farmers' Bone and Fertilizing Company, of Philalphia. The sample for analysis was sent by the secretary of the State oard of Agriculture, and contains:

Moisture,	= 3.28	per cent.
Soluble and reverted phosphoric acid,	= 4.60	do.
Equivalent to bone phosphate of lime,	=10.04	do.
Insoluble phosphoric acid,	= 0.20	do.

Equivalent to bone phosphate of lime, . . = 0.43 per cent.
Potash, ... =14.86 do.
Nitrogen, ... = 2.98 do.
Equivalent to ammonia, ... = 3.63 do.

The value of one ton, of 2,000 pounds, of this fertilizer is as follows

92 pounds soluble and reverted phosphoric acid, = $9 20
4 pounds insoluble phosphoric acid, ... = 16
297.2 pounds potash, ... = 20 80
72.6 pounds ammonia, ... = 12 71
$42 87

22. "Ammoniated Bone Phosphate."

Sold by Messrs. Passmore & Cope, Chester county, Pa. The sampl was sent for analysis by the secretary of the Pennsylvania State Board o Agriculture, and contains :

Moisture, ... = 4.20 per cent.
Soluble and reverted phosphoric acid, . . = 9.68 do.
Equivalent to bone phosphate of lime, . . =21.13 do.
Insoluble phosphoric acid, ... = 0.27 do.
Equivalent to bone phosphate of lime, . . = 0.59 do.
Nitrogen, ... = 2.19 do.
Equivalent to ammonia, ... = 2.66 do.

The value of one ton of this fertilizer is as follows:

193.6 pounds soluble and reverted phosphoric acid, =$19 36
5.4 pounds insoluble phosphoric acid, ... = 22
53.2 pounds ammonia, ... = 9 31
$28 89

23. "Buffalo Ammoniated Bone Superphosphate," or "Honest Fertilizer,"

Manufactured by Mr. L. L. Crocker, Buffalo, N. Y. The sample fo analysis was furnished by the secretary of the Pennsylvania State Boar of Agriculture. It contains :

Moisture, ... = 9.33 per cent.
Soluble and reverted phosphoric acid, . . =11.52 do.
Equivalent to bone phosphate of lime, . . =25.15 do.
Insoluble phosphoric acid, ... =12.22 do.
Equivalent to bone phosphate of lime, . . = 4.85 do.
Potash, ... = 0.13 do.
Nitrogen, ... = 3.10 do.
Equivalent to ammonia, ... = 3.76 do.

It contains, in one ton of 2,000 pounds:

230.4 pounds soluble and reverted phosphoric acid, worth, ... $23 0
44.4 pounds insoluble phosphoric acid, worth, ... 1 7
2.6 pounds potash, worth, ... 1
75.2 pounds ammonia, worth, ... 13 1
$38 1

24. "Soluble Pacific Guano,"

anufactured by the Pacific Guano Company, of Boston, Mass. The mple for analysis was furnished by the proprietors, and contains:

Soluble phosphoric acid,	= 5.26	per cent.
Equivalent to bone phosphate of lime,	=11.48	do.
Reverted phosphoric acid,	= 3.81	do.
Equivalent to bone phosphate of lime,	= 8.32	do.
Insoluble phosphoric acid,	= 2.12	do.
Equivalent to bone phosphate of lime,	= 4.62	do.
Potash,	= 2.12	do.
Nitrogen,	= 2.22	do.
Equivalent to ammonia,	= 2.69	do.

This represents the following values, per ton of 2,000 pounds:

181.4 pounds soluble and reverted phosphoric acid,	=$18 14
42.4 pounds insoluble phosphoric acid,	= 1 70
42.4 pounds potash,	= 2 97
53.8 pounds ammonia,	= 9 42
	$32 23

25. "Patapsco Guano,"

anufactured by the Patapsco Guano Company, of Baltimore, Maryland, ho furnished the sample for analysis. It contains:

Soluble phosphoric acid,	= 3.26	per cent.
Equivalent to bone phosphate of lime,	= 7.12	do.
Reverted phosphoric acid,	= 7.48	do.
Equivalent to bone phosphate of lime,	=16.33	do.
Insoluble phosphoric acid,	= 3.13	do.
Equivalent to bone phosphate of lime,	= 6.83	do.
Nitrogen,	= 2.98	do.
Equivalent to ammonia,	= 3.62	do.
Alkaline sulphates,	=10.35	do.

One ton of this fertilizer contains:

4.8	pounds	soluble and reverted phosphoric acid,		worth,	=$21 48
2.6	do.	insoluble	do.	do.	= 2 50
2.4	do.	ammonia,		do.	= 12 67
7	do.	alkaline sulphates,		do.	= 2 07
					$38 72

26. "Grange Mixture,"

anufactured by the Patapsco Guano Company, of Baltimore, Maryland, ho furnished the sample for analysis, which gave:

Soluble phosphoric acid,	= 4.20	per cent.
Equivalent to bone phosphate of lime,	= 9.17	do.
Reverted phosphoric acid,	= 8.32	do.
Equivalent to bone phosphate of lime,	=18.16	do.

Insoluble phosphoric acid,	=1.77	per cent.
Equivalent to bone phosphate of lime,	=3.86	do.
Nitrogen,	=2.03	do.
Equivalent to ammonia,	=2.47	do.
Alkaline sulphates,	=12.72	do.

According to this analysis the value of one ton would be:

250.4	pounds	soluble and reverted phosphoric acid,	=$25 04
35.4	do.	insoluble do	= 1 42
49.4	do.	ammonia,	= 8 65
254.4	do.	alkaline sulphates,	= 2 54
			$37 65

27. "A B Phosphate."

It is manufactured by Messrs. P. Zell & Sons, of Baltimore, Maryland who sent the samples for analysis, which gave:

Moisture,	=14.15	per cent.
Soluble phosphoric acid,	=5.90	do.
Equivalent to bone phosphate of lime,	=12.88	do.
Reverted phosphoric acid,	=4.90	do.
Equivalent to bone phosphate of lime,	=10.70	do.
Insoluble phosphoric acid,	=2.15	do.
Equivalent to bone phosphate of lime,	=4.69	do.
Potash,	=1.04	do.
Nitrogen,	=2.07	do.
Equivalent to ammonia,	=2.51	do.

The value of one ton of this fertilizer is as follows:

216	pounds	soluble and reverted phosphoric acid,	worth,	$21 6
43	do.	insoluble do.	do.	1 7
20.8	do.	potash,	do.	1 4
50.2	do.	ammonia,	do.	8 7
				$33 5

28. "Popplein's Silicated Superphosphate Lime,"

Manufactured by Popplein Silicated Fertilizer Co., of Baltimore, Marylan The sample for analysis was received from the secretary of the Pennsylvania State Board of Agriculture.

It contains:

Moisture,	=17.24	per cent.
Soluble and reverted phosphoric acid,	=10.34	do.
Equivalent to bone phosphate of lime,	=22.57	do.
Insoluble phosphoric acid,	=1.74	do.
Equivalent to bone phosphate of lime,	=3.68	per cent.
Soluble silicic acid, (Diatoms,)	=13.07	do.
Potash,	=2.80	do.

The value of this fertilizer, taking the diatomous silicic acid at five cents per pound, would be as follows:

206.8 pounds soluble and reverted phosphoric acid,	=$20 68
34.8 pounds insoluble phosphoric acid, ...	= 1 39
261.4 pounds soluble silicic acid, (Diatoms,) . . .	= 13 07
56 pounds potash, ...	= 3 92
	$39 06

The above analyses show that many of the superphosphates of lime contain too large a quantity of insoluble phosphoric acid, which has comparatively a very small value.

29. Poudrette.

I have an analysis of "Poudrette" from Peysson's Poudrette Company of Philadelphia, which gave:

Phosphoric acid, ...	=2.71	per cent.
Equivalent to bone phosph. of lime, . . .	=5.92	do.
Nitrogen, ...	=1.11	do.
Equivalent to ammonia, ...	=1.35	do.
Potash, ...	=0.32	do.

The value of one ton of 2,000 pounds of this fertilizer is:

54.2 pounds phosphoric acid, ...	=$2 17
27 pounds ammonia, ...	= 4 73
6.4 pounds potash, ...	= 45
	$7 35

30. Poudrette.

A sample of "Poudrette" from the Wilmington, Delaware, Poudrette Co., was analyzed by Doctor T. R. Wolf, the State Chemist of Delaware, who kindly communicated the result of his analysis, which gave:

Phosphoric acid, ...	=0.546	per cent.
Equal to bone phosph. of lime, ...	=1.19	do.
Nitrogen, ...	=1.07	do.
Equivalent to ammonia, ...	=1.30	do.
Potash, ...	=0.57	do.

One ton of this Poudrette is worth as follows:

11.9 pounds phosphoric acid, ...	=$ 48
26 pounds ammonia, ...	= 4 55
11.4 pounds potash, ...	= 80
	$5 83

SELECTION AND VALUATION OF FERTILIZERS.

BY THE SECRETARY.

Of the many questions which have been brought to my notice during the performance of my duties as secretary of the board, none has recurred with greater frequency than that of "what fertilizer shall I buy?" It is true that in many cases it has been submitted in a variety of forms, but nearly all are easily reducible to the above query. If, as has been the case in a few instances, it was changed to, "What fertilizer do you buy?" its answer would be much more easily given, and it is, perhaps, unfortunate that the terms are not synonymous.

In an extended correspondence with the farmers of our State upon this question, the reader would be surprised at the amount of conflicting testimony which will accumulate. One is almost extravagant in his praise of a certain brand, which another finds does not give him an adequate return for the money expended, but *he* is very certain that a second make, which he names, will always give entire satisfaction, and a third furnishes evidence contradictory to both. One class will assert that a judicious investment in commercial fertilizers will return two dollars for each one expended, while another class are equally certain that such an investment will not pay.

One of my correspondents, in reply to a similar question, answers to the effect that the best, most effective, and economical commercial fertilizer is one which contains all the elements needed by the crop to which it is applied. This argument would no doubt apply to a perfectly sterile soil, but in practice we do not have to deal with such, for all soils contain more or less of some of the elements of plant food and that, too, in sufficient abundance for many crops; in many cases, this may not be in an available form, but in such cases it is often more economical to render it available than to apply more in a directly available form. Hence we have differed with our correspondent, and have assumed that the most economical fertilizer is one which furnishes all the elements of plant food which cannot be obtained from the soil at a less cost than by direct application.

It is possible that the direct application of a complete fertilizer (one which contains all the elements of the crop) may result in a loss; in fact, that the too general acceptance of this definition has been the cause of no small loss by causing the application of elements not needed, and from those which were needed not being supplied in sufficient amounts.

All agree that the three essential elements of a fertilizer are phosphoric acid, ammonia, and potash. But are they all absolutely essential in all